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DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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ASTRONOMY AT THE AMERICAN ASSOCIATION

BY J. A. PEARCE

The American Association for the Advancement for Science held its seventy-fourth meeting at Toronto from December 27th to 31st, 1921. This was the second in Toronto, the first having been in 1889. Section D is devoted to Astronomy. On the morning of Wednesday, the 28th, there was a joint session of Section D with the Royal Astronomical Society of Canada at which the program was:

1. Observation versus Experimentation. Address of the retiring Vice-President of Section D, JOEL STEBBINS, University of Illinois.
2. Popularizing Astronomy. C. A. CHANT, University of Toronto.

On Wednesday afternoon and Thurdsay morning and afternoon the Royal Astronomical Society of Canada furnished the program, which was as follows:

1. Systematic errors in micrometer measurements. RALPH E. DELURY, Dominion Observatory.
2. Wireless in the Mackenzie Basin. J. P. HENDERSON, Dominion Observatory.
3. Estimations of linear divisions. R. J. MCDIARMID, Dominion Observatory.
4. The thermo-electric photometer at Ottawa. R. M. MOTHERWELL, Dominion Observatory.
5. Systematic errors of circle readings. C. C. SMITH, Dominion Observatory.
6. Comparison of wireless time-signals from Annapolis and Lafayette. R. MELDRUM STEWART, Dominion Observatory.
7. Chronographic recording of wireless time-signals. R. MELDRUM STEWART and J. P. HENDERSON, Dominion Observatory.
8. The Municipal Observatory of the Drake University. D. W. MOREHOUSE, Des Moines, Ia.

9. Comparison of trigonometric and spectroscopic parallaxes. S. A. MITCHELL, Leander McCormick Observatory.
10. Second note on Cepheid variation. RALPH E. DELURY, Dominion Observatory.
11. Meridian circle observations of circumpolar stars. W. S. MCCLENAHAN, Dominion Observatory.
12. The stars of the Beta Canis Majoris type. F. HENROTEAU, Dominion Observatory.
13. The pickering series in O-type stars. H. H. PLASKETT, Dominion Astrophysical Observatory.
14. Three spectroscopic orbits, each based on both component spectra. W. E. HARPER, Dominion Astrophysical Observatory.
15. Orbit of the spectroscopic binary H.R. 5992. J. W. CAMPBELL, University of Alberta.
16. Measurements of the distance of the sun, deduced from its spectrum. RALPH E. DELURY, and JOHN L. O'CONNOR, Dominion Observatory.
17. The present status of meteor observations. C. P. OLIVIER, Leander McCormick Observatory.
18. Old observations bearing on the duration of sunrise. WILLARD J. FISHER, Cambridge, Mass.
19. The origin of the rotation of the planets, experimentally illustrated. WILSON TAYLOR, University of Toronto.
20. The influence of astronomy on medicine. JOHN B. FRASER, Toronto.
21. Latitude by observation of stars at elongation. L. B. STEWART, University of Toronto.
22. Star Streams. E. E. BARNARD, Yerkes Observatory.
23. A variation following universal time. LOUIS A. BAUER, Washington, D.C.

For the Wednesday morning session Professor S. A. Mitchell, of the Leander McCormick Observatory, the Vice-President of Section D, occupied the chair. For the other sessions, by request, Dr. Klotz, Director of the Dominion Observatory, Ottawa, presided. The meeting was a decided success. The attendance was good, some ten members of the staff of the Dominion Observatory as well as visitors from Syracuse, Chicago, Des Moines, Denver and other distant points being present. The meeting of the A.A.A.S. as a whole was also a great success. About 1,800 members registered, about twice as many as estimated beforehand, and the arrangements made by the local committee for entertaining them were declared to be exceptionally good.

In the present issue of THE JOURNAL some of the papers presented are printed. In later issues it is intended to publish other papers either in full or in abstract.

ASTRONOMY IN A POET'S LIFE

By Albert Durrant Watson

(*Concluded from last issue*)

The poet, of all men, sets up on every wayside of life the device: "*Sic iter ad astra.*" He sees in every blossom the eternal beauty, in every star the universal law. To him the coming forth of "Mazzaroth in his season" is a demonstration of that order in obedience to which, and by whose virtue, every planet and every pebble keeps its orbit. For the poet is a creator, as the word implies. Imagination which is the recombination of concepts into a new picture, is the poet's creative faculty. By it he calls forth new compositions and effects. They march into the highways of being in submission to that soul which, having been faithful in a few things, is made ruler over many things.

Everyone has a definite range of influence, a field of activity, a circuit of power. Most of us short-circuit our lives. We do it deliberately not realizing, however, that by devoting our attention to local and temporary interests, we render our lives ineffectual in the larger and more constructive fields. This short circuit exhausts the current and often burns out the system. A supreme choice made lightly and foolishly, sometimes wastes a life. Foundation-building takes time and patience. The reward is all the greater. Large results demand thought, concentration, persistence. Of all scientific men, perhaps none is more patient than the astronomer. He sees the ample sweep of the stars, and rejoices in their largeness of scope and exactitude of motion.

The astronomer feels his physical unimportance as a part of the material universe. Consequently, he is an unassuming person. His voice is not heard in the street. He knows the earth is but a planet, and that even its primary is not conspicuously brilliant as compared with other stars. Small as the earth is, man is infinitely smaller. There is no virtue in shouting from the housetop about one's own importance. The astronomer knows this.

The true poet is as unpretentious as the astronomer, yet he

feels himself, as a soul, to be an essential part of the whole system. He knows the currents of the larger life are moving within him, and that, whether he drift or drive, his polarity must be that of the whole, or he will be as the fine dust of the balance, a negligible quantity. Hence, he attunes life to a major chord; he keys himself to the music of the spheres, and knows that his fate, whatever it may be, must be noble. This is true both of the astronomer and the poet. The sense of security in such a universe as ours is a species of real greatness, nowhere more serenely present than in the astronomer-poet.

Of all contributions to science made by the poet, the finest is that he perceives and reveals that harmony of nature and unity of life of which the astronomer discovers the details in the hitherto unknown continents of truth. The poet constructs those continents out of the merest hints of discovered truth, accepting the slightest fact and clothing its implications with all those robes of taste and style of metre and rhyme, which give to truth the distinction of beauty and strength, the perennial loveliness of everlasting youth. It is only by careful and patient collaboration that we may hope to set facts in their proper order in that marvellous crescendo of life known to us as the present scientific age.

How finely have some of our poets served their times. What a champion in the fields of science was our English Tennyson. His vision perceived the truth of the new thought while it was yet new. He saw it forged and accepted it as truth. His allusions to science are accurate, yet he never lowered, for the sake of accuracy, the high poetic quality of his work. His genius was sufficient to compass both. His interest in astronomy was genuine. He had a telescope on his own estate, and often, when he needed a more powerful glass, visited his neighbour, Norman Lockyer, with whom he was on intimate terms of fellowship. Tennyson had the benefit of knowing the work of Newton, Herschel, Laplace and Darwin. He based his conception of science upon their results. He never bent his facts by a hairsbreadth to make a pretty picture as, for instance, did Coleridge when he spoke of

> "Yon horned moon with one bright star
> Within its nether tip."

Had the bright star been placed *beneath* the nether tip of the horned moon, the picture would have been more beautiful, because it would have been true.

Dante, finding a cosmogony already constructed for his use, made it the foundation of his *Divina Commedia*.

Milton was aware of the results obtained by Copernicus, Galileo, Columbus, Magellan and Vasco da Gama, yet he incorporated into his epic something of the older theory. He had visited Galileo and looked through his "optick tube," but he was discreet.

As members of the Royal Astronomical Society of Canada, we should know that, of those who most have enshrined science in song, our own Bliss Carman, born on "the rim of the sea," rivals the greatest of lyrists in some of his "Songs of the Sea-Children," wherein he so often speaks of the heavens. What could be more delightful than this reference to the meteors:

> "As down the purple of the night
> I watch the flaring meteors race,
> The gorgeous bedouins of the dusk
> Making across the glooms of space."

or than his reference to the earth, when he says:

> "The world is swimming in the light,
> Sheer as a bubble, green and gold."

These are accurate descriptions of certain phases of the noblest of all sciences. Nothing could, I think, be more beautiful than some of his pictures of the sky when

> "The large fresh night emerges
> From the sea."

Here is a poet worthy to be a laureate.

In a volume of poems entitled *The Modernists* from the pen of that other gifted Canadian, Robert Norwood, I find these lines taken from a monologue *Balthazar Magus*.

> "The moon is down.
> I saw one horn of her gore at a cloud
> Low on the desert . . . . . .
> Whose the hand
> That turned the Dipper down and emptied it
> Of all its gold now scattered on the sky?

In vain the Little Dipper intervenes—
The flood spills past its proffered brim to flow
Into the waiting coffers of the night!
Vega, did'st thou do this?
There Libra stands
To weigh the gold. How many talent worth,
Dear Lady of the Scales, shall Vega have
For marriage portion, if she weds Arcturus?
Let her now pray at Virgo's shining feet
A blessing on her nuptials! Let the sheaf
That Leo's sickle reaped content the maid—
Gold is for Kings—Arcturus cares for sheep!"

Norwood is another of our—not loved and lost, but of our lost and loved, for this seems to be the natural sequence.

The realization of the spiritual and artistic importance of astronomy is in evidence in the work of other and younger Canadian poets. An example is to be found in *The Beckoning Skyline* by J. Lewis Milligan. In a short poem entitled *Divine Astrology* a conjunction of Jupiter and Venus is referred to in which

"fair Venus and proud Jove
Meet as for nuptials in the purple light,
The marriage of Omnipotence and Love."

In the old days, poetry was almost a component part of astronomy, medicine and religion, then the three classical professions. The three were a trinity in unity, for usually one person was priest, astrologer and alchemist or healer. This person was nearly always a poet of some sort. One does not blame Plato who, in his *Republic*, disparaged the influence of the poet upon the scientific mind when one considers the kind of poet some of these nondescript persons were. On the other hand, it must be remembered that Plato himself had the poet's soul beyond the common measure. Indeed, that indescribable robe of beauty, colour and charm with which poetry adorns the significant facts of science, and which we often somewhat loosely, name romance or atmosphere, has received from the best minds of the ages an appraisement almost beyond the value of the facts themselves.

The function of the poet is to clothe the latest word of knowledge in a robe of suggestiveness and joy, and thus celebrate the nuptials of science and song. He should make science so attractive

to mind and heart, because of the beauty of its salutations in verse, that the truth by him adorned shall sing itself forever in the consciousness of the race. A volume containing such a collection of poems is an immediate desideratum. Here is a field of activity for someone who needs not the gift of poetic expression for himself, but rather that discriminating faculty which recognizes both science and poetry with a taste so fine that it would close the door to all beauty, however delightful, if unscientific; and, with equal firmness, to all science of inferior poetical expression.

Such a collection of science in song would be, for the present, quite slender, and alas! in the astronomical field, more so than elsewhere. Nevertheless, the search for scientific knowledge clothed in beauty and distinction would be a worthy task for one whose powers have not yet found a suitable avocation. If chosen with discrimination, the collection would well repay the labour, if only with the sense of work well done. The danger of making the choice too generous would best be met by collaboration, two working together, one with distinctively scientific faculties, the other with purest poetical taste.

The astonishing meagreness of the supply of astronomical poetry leads one to suspect that he who would clothe the facts of such a majestic science in satisfying adornment of verse must have the highest gift of inspiration in song, as well as a knowledge of the science of astronomy not liable to stumble among the latest conclusions. The object of such verse is to make science a joy to the mind that loves beauty. This requires the power to express knowledge simply in poetic phrase, keeping the work on a plane of dignity which, whenever appropriate, should take wing and rise to a majesty commensurate with the sublimity of the theme presented.

Such work cannot be done in a formal or perfunctory way. It must not be a task, but a flame-like urge in the poet's soul. The work must spring full-orbed to radiant numbers, in lines of spontaneous loveliness, and stanzas of lyrical grace, setting forth the glories of nature and of law. Is not our earth a vast ship sailing in a sea of ether to a destination more beautiful than any Forest of Arden or Isle of Avalon! That dream which we name 'truth' comes to the poet with reality. It is to him the music

of the universal chord. The song of the morning stars is as yet only in rehearsal. The astronomer-poet hears that rehearsal in its finest form. Others do not take thought to the limit of their highest appreciation. Their poverty of emotion comes of their mental sloth. In some instances they become dogmatic, a quality which is always a sign of narrowness and limitations. How poor and base is the common coin of conversation of those who though they have knowledge of science, have no taste in art! How much we all might enrich our vocabulary were we occasionally to use a line of beauty—some

> "Jewel five words long
> That on the stretched forefinger
> Of old father Time,
> Sparkles forever."

The astronomer has been sometimes a disturber of what men thought was their faith, a thorn in the side of the dogmatist. Neither Darwin with his biological theses, nor Lyell with his geological innovations, challenged the creeds of men more boldly or fundamentally than did Copernicus, Galileo, and others whose revolutionary thought seemed to upset the whole religious fabric. Evolution, demanding a faith infinitely larger than that of the past, called out restatements of nature's methods with their inevitable theological implications. The poet has almost always been ready to go forward with science to the frontiers of thought. The astronomer-poet conceives a reasonable view of nature where faith is consistent with fact and knowledge begets reverence and humility.

A purely intellectual comprehension of science could not be the basis of an adequate philosophy of nature and of life if the scientist, and more especially the astronomer, had not looked into the firmament of truth with a poet's eyes of comprehending vision, and with some conception of a reality behind the phenomena. He could not have seen his own life-star in true relation with the universal without that second sight which preceives the meaning of the isolated facts. As daylight hides from view the immensities of night, so the light of the intellect, busy with the microscopic interests, is blinded by the effulgence of the sun of lesser truth, and intelligence, and fails, therefore, to get the clear revelation

of the larger vision. The poet has an eye with a longer focus and should look, in the person of the astronomer if possible, through the telescope. The astronomer without poetic insight fails to see beyond the limits of mortality, and therefore feels insecure as to the permanency of his own consciousness.

The authentic poet realizes the value of the shadow and, from the vantage of its wider vision of inspiration, grasps the larger implications of life and nature. He finds them extending into other dimensions, and moving at higher velocities than instruments in daylight can measure. Below our levels of consciousness, all seems to us to be error. Above them, all seems visionary. But the poet has the power to rise to higher levels of vision where those things which seem so foolish to the common consciousness are as real to him as the stars in the revealing night. His statement of what he sees may seem to the unpoetic mind to be dogmatic, but surely the poet knows what he sees as well as does the observer of physical phenomena. He is observing in a different field—his own field. How then shall others who have not seen his vision declare that he is mistaken? The negative is not greater than the positive. Those who see the most are always in the minority. Shall the blind declare there is nothing to see!

In this paper I have endeavoured to show that imagination and reverence are astronomic auxiliaries of high value and importance, forasmuch as they clothe thought with robes of joy and wonder. They do for science what style does for literature, adorning it so subtly with the graces of personality that it seems to be quite impersonal and sublime. But this fine result is never reached by a sudden resolution. He who says: "Go to, I will be an astronomer; I will write an authentic poem," will do neither till he gives his life to the work and empties a rich and rare quality of soul into the task. All fine results in this or any other sphere of activity demand resolute devotion and diligent application.

But each in his own field. The highest result for the astronomer demands a thorough knowledge of the science. The supreme achievement of the poet will grow out of his vision, taste, and realization of the incomprehensible. Neither the astronomer not the poet can afford to ignore those standards of learning and literature without which both will be sure to fall into fads, philis-

tinism, and futility. Only such devotion can accept the challenge of Tennyson to

> "Burst the folded gloom
> To bare the eternal heavens again,
> To feel once more, in placid awe,
> The strong imagination roll
> A sphere of stars about the soul,
> In all her motion one with law.'

The sense of wonder and joy, begotten by the harmony and amplitude of the unboundaried field of astronomical research, helps the mind to discover and to reveal in those modes of being and motion ever emerging to our ken, and leading us in humility and light to wider worlds of imagination and vaster fields of thought. That surely is a sublime kingdom which lies before the master artist who would sing for us the new canticles of the sky.

> Ablaze in glorious tracks of light,
> Along their fiery orbits swing
> A thousand constellations bright—
> "Make way for God" they sing!

In the *Journal of The Royal Astronomical Society* for July-August 1910, an able paper is published from the pen of Mr. J. A. Paterson, entitled "Art and Astronomy." A series of interesting papers has recently been presented before this society, showing the interrelation existing between astronomy and the other arts and sciences. Inasmuch as all science and art, all religion and ethic, arise in one universal Source, what is more natural than that we should find evidences of their unity in all our investigations.

In view of the international efforts now being made to disarm the world and abolish war from land and sea, it seems appropriate that in all arts and sciences, religion and commerce, politics and industry, as well as in our international and social relations, the great principle of mutuality should be observed. All prejudice should be abolished, while those movements which serve to unite the human race should be strengthened. All divisive policies, all offensive actions, even narrow patriotisms should be scrutinized with suspicion, *especially if they be our own*, for all men and all nations are from one Source.

The day of conference and counsel has come. In cleaning up the muss that has been made of civilization, while recognizing the claims of the larger justice, it is sincerely to be hoped that we shall abandon all self-righteousness. We know there can be no peace on earth for any one till there is good-will in his own heart. What is true of one individual is also true of the nation and the world. Not until there is kindliness in our hearts towards all can we take the position of the astronomer and the poet, and, scrutinizing our own disposition and practice, enquire: "How will this look in the universe?"

Who loves his native land is wise.
More glorious he whose visioned eyes
Doth see our God in every face
Beneath the blue and bending skies.

One God is ours, one earth, one air,
One sea; one sky is everywhere.
The world is not so very wide,
And heaven hath only one bright stair.

WIRELESS IN THE MACKENZIE BASIN

By J. P. Henderson

FAR away into Canada's great North-West where for past ages the only science that has been known has been the science of the hunter, trapper or trader, the past year has seen not only the introduction of the most modern drilling and mining machinery but also has demonstrated the need of wireless, the very last word in modern means of communication.

Almost a year and a half ago a little launch left a secluded spot far down the Mackenzie—such a launch as any of us might be proud to cruise around in on leisure evenings in sheltered bays, *Redwing* was its name—this it was that made the 1,200 miles against a strong head current, a distance comparable to that across the ocean when the speed of the current in this great river is considered; but it was the only available means of carrying news to the outside, and a few days after its arrival at the telegraph office at the end of the railroad the whole world had turned and had taken notice—could it be that there was here another district in which to make countless millions out of oil?

The past summer has been one of intense activity all through the country. The Government has been making great efforts not only to attempt to maintain the high record of our Northland for honesty and comradeship but also to assist all *bona fide* development schemes while discouraging the pure speculator. New and improved maps are in course of construction based on accurate surveys of the only thoroughfares, the rivers. In connection with the fixing of these surveys a party was sent out from the Dominion Observatory at Ottawa to determine astronomically the latitude, longitude and the gravity at selected points, and for the purpose of receiving the necessary time signals for chronometer correction a portable long-wave receiving set was used.

Perhaps no country in the world needs a chain of wireless stations more than our great North-West. It is doubtful whether a wire telegraph line could ever be installed and successfully

maintained throughout the country, owing to the muskeg character of much of the distance to be traversed. Even a short stretch of 16 miles of telephone poles at Smith has to be constantly repaired owing to poles tipping and falling in the soft marshy ground. What would become of 1,200 miles of poles over such country is not worth mentioning.

At Peace River, Alberta, a comparison of the results using a through wire from Ottawa and the wireless time signals from Annapolis was made. A jump was then made by steamer and launch, varied by team and walks across the portages, to Providence, about 60 miles beyond Great Slave lake. This lake, which is very much larger than lake Ontario, is quite cold most of the summer, ice just leaving it about the beginning of July, provided much in the way of amusing sights for the uninitiated or food for the thought of the scientist, a favourite prank being to show ahead an island in the sky, enlarged and upside down, when really no island was within many miles. At Providence with the wireless we were repeatedly made aware that it was also a nest of thunderstorms, many of which actually did come our way. The "static" was particularly troublesome, and this, coupled with the continual daylight that we had while at Providence, made wireless receiving particularly difficult; but in this connection it might be said that trouble with atmospherics has been general all over the world this summer. A large rotating loop aerial was tried out here with some success, and though additional amplification by audion bulbs was necessary more than with the quarter mile single wire antenna its use in adverse conditions seemed advisable.

At Norman near the oil wells even greater difficulty in the reception of the Atlantic coast station Annapolis was experienced, and a compound directive aerial system was erected which served to increase the strength of signals coming from a southeast direction and also to neutralize the effects of the western stations and static as well. A large area of Pre-Cambrian geological formation over which the signals had to pass and which contained minerals, mostly iron—a large change in the deflection of the magnetic needle has long been observed in this district—was probably responsible for the difficult reception of signals from this direction. Among those which normally were much louder at this point

might be mentioned San Diego, Panama, Honolulu, and the Philippine Is., this latter being about 6,000 miles distant.

The gravity and longitude determinations were possible only by means of the wireless time signals by which were obtained accurate ratings and corrections of the field chronometers used. Approximate values were obtained on the spot but the final values could only be obtained by reference to the corrections that should be applied to the signals as determined at the head observatory in Ottawa.

Only within recent years did such scientific work in distant fields become possible. The most modern valve receiving and amplifying equipment was used and, even this was specially designed for the long wave-lengths in the light of recent research and made with the co-operation of the Test Room of the Department of the Naval Service of Canada.

With great white and gaily-coloured dancing sheets of aurora that flitted nightly all over the heavens, every opportunity was embraced of studying their connection with wireless reception and other atmospheric phenomena.

Dominion Observatory,
Ottawa, Dec. 21, 1921.

STAR STREAMS

By E. E. Barnard

IN the study of photographs of the sky made with portrait lenses one is often struck by the frequent occurrence of stars of nearly equal brightness in straight or curved lines extending over considerable space. In some cases so striking are these peculiarities that there is a temptation to believe the arrangement is not fortuitous and that these stars are in some way related to each other.

I speak of these in connection with portrait lenses because in general the scale of such photographs is small and the peculiarities are more accentuated with them. I think it has been claimed that they are produced by the small scale of such lenses. This can only be partly true, however, and in but relatively few cases, for in many cases the peculiarity is so marked that one must admit there is a strong probability, if not a certainty, that a physical connection exists among the stars involved in the phenomenon, as if some common force had compelled the apparent drift. These usually occur on parts of the sky where the stars are uniformly scattered on a dark ground. It is here that one is struck with the presence of a great many lines of small stars and of narrow dark or vacant lanes, usually of uniform width. So plentiful are these features in some regions that they look like a geometrical pattern. This is specially striking in a part of Cygnus in R.A. 20h 20m, Decl. +36° and near the great nebula of Andromeda and elsewhere. It seems to be present in many cases wherever the stars are plentiful and uniformly distributed.[1] While it is true that similar striking appearances are sometimes produced by small star-like frost crystals or by minute drops of moisture formed at the beginning of a misty rain on windows, one can hardly feel sure that even these are entirely due to a chance arrangement of the particles of moisture, etc., and that there is not some law governing their arrangement.

Before dealing with individual cases of apparent connection,

[1]See *Pub. L.O.*, Vol. XI., Plates 54 and 84.

let us assume that these curves of stars are really due to some common physical law—that there is a common drift which causes the stars to string out in straight or curved lines and that they are more or less following an individual path, or parallel paths. What would be the effect on the photographs if a whole region of stars had such a common drift? Is it not possible that this drift would be recognisable in the general appearance of that region? Would not the effect of the general trend be visible on the plates if the greater number of the stars were going in the same general direction, while the stars of neighbouring regions were moving in various directions or, in effect, stationary.

I have before called attention to certain regions of the Milky Way where a stream-like appearance of the stars is evident. There are apparently broad streams of stars which seem to have a common trend. This appearance usually occurs in a very dense region, and resembles that which might be produced by the sweep of a giant broom. In some cases these "sweeps" are apparently connected with vacant regions, as if there were a common drift of the stars away from these places. A striking case of this kind occurs in Scutum, where the appearance is that of streams of stars diverging from or converging to a vacant region at this point in R.A. $18^h\ 25^m$ Decl. $-11°$, and is also evident in R.A. $21^h\ 15^m$, Decl. $+57°$.[2] It is best shown in R.A. $16^h\ 55^m$, Decl. $-34°$.

From looking at the pictures one gets the impression that the great mass of stars over a considerable region often have a common drift in a certain direction.

The detection of a general drift of this kind by looks alone does not seem possible. Yet the impression of such a condition constantly forces itself upon one as a probability when examining certain parts of the Milky Way. However questionable this idea may be, there can be no objection to calling attention to some of the regions that have attracted my notice. Though the explanation of these appearances may seem chimerical as to the reality of these drifts or the possibility of detecting them by looks alone, I think it is not so absurd as it may appear at first sight. Suppose, for instance, on a sandy space there has been a gentle and wide flow of water which has carried the sand with it without digging

[2]See *Pub. L.O.*, Vol. XI., Plates 57, 62 and 78.

out a bed or channel. Suppose the water to subside. We will then find where the water flowed full evidence, from the appearance of the sand particles alone, that there had been a flow of the sand at that place.

It is this sort of arrangement of the stars with respect to those near the apparent stream that seems to give the impression of a general flow or drift in the regions mentioned. I see no serious objection to the idea. Of course the verification of these supposed broad streams or drifts of the stars must be left to time.

It might be said that this possible drift could be tested by an investigation of the motions of the catalogued stars in the regions in question. But the proper motion of the known stars in the direction of the supposed drifts cannot be used as a test of this apparent motion because the stars that make up the general structure of the Milky Way are faint and vastly farther away than the known stars. Indeed if all the stars brighter than 11th or 12th magnitude (among which will be all the known stars) were removed from the sky, no change would be noticed in the great clouds of the Milky Way because these clouds are probably formed by stars fainter than 11th or 12th magnitude. It is, therefore, probable that no direct relation exists between the motion of the known stars in these directions and of those that make the great structures of the Milky Way.

Yerkes Observatory.

METEORIC ASTRONOMY

By C. P. Olivier

Of all branches of the science meteoric astronomy has so far received least attention. Had it depended only upon professional astronomers and study at regular observatories, our present knowledge of this branch would be small indeed. It is true that several astronomers of world-wide reputation, among whom Schiaparelli is perhaps best known, have put much time and study upon meteoric phenomena, and to their efforts are due largely our theoretical knowledge. This in the nature of the case must be true, as the average amateur has not the basic mathematical training nor the experience in combining observations which can come only from residence in a research observatory. Yet the observations themselves, the necessary data for the theory, have largely been made by amateurs and it is to their lasting credit that we have gone as far as we have to-day.

A brief summary of the situation in 1921, as far as obtainable published reports show, seems to be about as follows. In England the Meteor Branch of the British Astronomical Association, not large in numbers but containing several very skillful and experienced observers, is most active all the year around. Large numbers of simultaneous observations of meteors are made and many real heights obtained. Also the main showers are regularly observed. A few of their members publish theoretical work. Occasionally professional English astronomers have recently published valuable mathematical papers on the subject. In France many persons seem to work on meteors and appear to send their results to the Société Astronomique de France, by which, due doubtless to financial troubles, they are seldom published. We therefore know little of their value. Recent files of the *Astronomische Nachrichten*, as well as other German periodicals, show that numerous persons in Central Europe are still at work, though the actual published amount is not great. No news has been received of the international Bureau Central Météorique which for some years prior

to 1914 was doing valuable work in Europe. If this society has died out it is most regrettable. A recent letter from Prof. C. Hoffmeister, of Sonneberg, Germany, tells of the founding of a private observarory mainly equipped to study meteors. Certain observers in Belgium and Denmark too seem active, but no news of meteoric work comes from Italy where a generation ago there was a flourishing and hard-working association for meteor study. The southern hemisphere offers a practically untouched field as there are scarcely half a dozen persons who apparently ever attempt observations. A really enthusiastic observer there could in a year or two accomplish wonderful things. In North America, the American Meteor Society, having suffered much from the war, has begun a real revival. Its active membership has always come from Canada and the United States, except one observer in Argentine and one in New Zealand. What it accomplishes will therefore be doubly interesting to members of the Royal Astronomical Society of Canada as doubtless some of them are also members of the A.M.S. Further to Dr. R. K. Young, of the Dominion Astrophysical Observatory, we owe the designing of the excellent series of gnomonic maps used by all our observers. These maps originally appeared in the *Journal of the Royal Astronomical Society of Canada* and then as Part 7, Vol. II, *Publications of the Dominion Observatory*.

First in importance this year was the publication of our results for the years 1914-1918 inclusive. This appeared as Part 7, Vol. II, *Publication of the Leander McCormick Observatory*, University of Virginia, and is based on 22,000 observations of meteors made during those five years. A glance over its contents will show that several Canadians took an active and creditable part. As this memoir had a large circulation no attempt will here be made to review its contents. The years 1919 and 1920 were depressing because of the general unrest which vastly affected our members among others, but 1921 has again shown some progress. To date 1800 observations have been sent in, made by 10 persons. Also the American Association of Variable Star Observers has generously co-operated in reporting telescopic meteors. On these data we eventually hope to form accurate tables of those wholly unstudied bodies. In August simultaneous observations made between McCormick Observatory and Washington, D.C., fur-

nished some good heights of meteors. At the former place the writer has been experimenting a little with the photography of meteors, securing a few results of value.

Finally, as to the needs of meteoric astronomy, they may be divided into two classes. First, a few well-equipped stations, under the charge of professional astronomers, who will concentrate their efforts on the photographic study of meteors and the trying out of any new devices of promise. The best results could be expected from two stations about five miles apart, each with a complete photographic equipment. This should include a device for making a narrow rod revolve in front of each camera lens a given number of times per second. This would leave a meteor's trail with a certain number of narrow breaks in it and hence give the means for determining its velocity when the heights have been calculated. Accurate velocities of meteors are perhaps our greatest single need to-day and no pains should be spared to secure a considerable number. Until this is done the writer considers many of the fundamental problems of meteoric astronomy absolutely unsolvable. The great trouble so far has been that our plates only photograph the brighter meteors and hence much time and expense are necessary to be certain of getting results of value. Doubtless the future will see this problem adequately handled but so far progress has been dishearteningly slow.

Secondly, is needed a vastly larger group of enthusiastic amateurs, in many different latitudes, who will work often and systematically enough to become really skillful, and who will make the regular observations so necessary for a complete and continuous knowledge of the subject. For the encouragement of the latter group it may be pointed out that the proof of coincidences between meteor streams and comet orbits, all the data for the calculation of paths of fireballs and meteorites, studies of the richness of the principal annual meteor showers and the detection of minor radiants, as well as numerous other things, so far have depended wholly upon naked eye observations. Since it is hopeless to expect the staffs of regular observatories to make more than very occasional observations on meteors, upon amateurs only can we depend. The field is a fruitful one, no telescope is needed, and the reward for an enthusiastic and skillful observer certain. It is

therefore hoped that the coming year, 1922, most favourable for meteor study as the moon will not interfere with most rich showers, will see several Canadian observers enter regularly into this field.

Leander McCormick Observatory,
University of Virginia.
Dec. 14, 1921.

THE STARS OF THE βCANIS MAJORIS TYPE

By F. Henroteau

STARS of the βCanis Majoris type would be called, at first sight, spectroscopic binaries of very short period (from 3 to 6 hours). Whether they are real binaries is perhaps, however, an open question.

The importance of the stars of this type lies not merely in the fact that they behave like very short period spectroscopic binaries, but that they present most interesting peculiarities consisting of variations of amplitudes, shape and period of the velocity curves as well as variations of the widths and intensities of the spectral lines. Each star of the type however appears to present peculiarities of its own.

Previous to 1920 only four stars of the βCanis Majoris type were well known and they were discovered to be very short period spectroscopic binaries only after long investigation. These stars were, βCanis Majoris discovered to be a very short period binary by Dr. Sebastian Albrecht at the Lick Observatory, βCephei discovered by Prof. E. B. Frost at the Yerkes Observatory, σScorpii studied by Father Selga at the Lowell and Lick Observatories and found by him to be of very short period, and 12 Lacertae discovered by Dr. R. K. Young at the Dominion Observatory in Ottawa.

Extensive investigations of βCanis Majoris which led to the discovery of variations of the amplitude of the velocity curve and variations of the widths of the spectral lines, were made by the author* at the Lick Observatory in 1917 and 1918. Variations of the amplitude of the velocity curve had already been suspected by Dr. R. K. Young in the case of 12 Lacertae. Other investigations by the author were made of σScorpii, first at the Lick Observatory in 1918 and continued at the Dominion Observatory in 1920 and 1921. σScorpii has a short period velocity variation of apparently constant amplitude and almost constant period (about

*Lick Observatory Bull., Vol. IX., p. 155.

six hours) but the mean velocity of the short period curve varies also in a period of approximately 34 days. This long period curve changes in shape and amplitude. A complete study of the system of σScorpii appeared as *Publication* No. 7 of Vol. V. of the Dominion Observatory, Ottawa.

The first step in the complete study of the stars of this type was to search for further examples; hence, since the latter part of 1919 a great many stars have been investigated at the Dominion Observatory with that end in view. They were most likely to be found among the stars of early class B and it is these that were first investigated. Spectrograms of the same star were taken successively all through the same night or a great part of the night, very frequently on several nights; the radial velocities were obtained from these spectrograms, the work of obtaining them being frequently laborious and the results in many cases not justifying the labour involved. (Long nights of observation and difficulties of measurements on account of the very poor character of these early class spectra; the lines are often wide, diffuse, and the velocities they give have large probable errors; the spectra of the stars of the βCanis Majoris type are however, in most cases very good, with fairly sharp lines.) I have to acknowledge here my indebtedness to Messrs. J. P. Henderson, J. F. Frédette and W. A. Thorn, the first having participated in the observations and the reductions in 1919 and 1920, while the two last named have taken a share of the reductions in 1921. From these observations a rather large number of stars have been discovered to be of the βCanis Majoris type or are strongly suspected to belong to this type. The following table gives all the stars which at present might be investigated as such.

These stars are of interest not only to the spectroscopist, but also to the variable star observer who has powerful means of investigation. Professor Guthnick, now director of the Berlin Babelsberg Observatory, using a photo-electric photometer, found for instance that 12 Lacertae shows a small variation of magnitude of the same period as the variation of radial velocity and that the amplitude of the light curve is also variable. This curve (published in the Jubilee number of the *Astronomische Nachrichten*) shows the interesting parallel between the photometric and the spectro-

STARS OF THE βCANIS MAJORIS TYPE OR SUSPECTED TO BE SO.

H.R.	Star	R.A. (1900)	Decl. (1900)	Visual Mag.	Spect.	Remarks
		h m	° ′			
779	δCeti	2 34.4	− 0 6	4.04	B 2	
1149	20 Tauri	3 39.9	+24 4	4.02	B 5	
1320	μTauri	4 10.1	+ 8 39	4.32	B 5	
1463	νEridani	4 31.3	− 3 33	4.12	B 2	
1641	ηAurigae	4 59.5	+41 6	3.38	B 3	
1810	114 Tauri	5 21.6	+21 51	4.83	B 3	
1931	σOrionis	5 33.7	− 2 39	3.78	B	
2294	βCan. Maj.	6 18.3	−17 54	1.99	B 1	Discovered by S. Albrecht
2344	10 Monocerotis	6 23.0	− 4 42	4.98	B 3	
2387	4 Can. Maj.	6 27.6	−23 21	4.35	B 1	
2490	42 Camelop.	6 40.5	+67 41	5.04	B 3	
2571	15 Can. Maj.	6 49.2	−20 6	4.66	B 1	
5062	g Urs. Maj.	13 21.2	+55 30	4.02	A 5	Discovered by E. B. Frost
6084	σScorpii	16 15.1	−25 21	3.08	B 1	Discovered by Fr. Selga
6453	θOphiuchi	17 15.9	−24 54	3.37	B 3	
7298	ηLyrae	19 10.4	+38 58	4.46	B 3	
7372	2 Cygni	19 20.2	+29 26	4.86	B 2	
7426	8Cygni	19 28.1	+34 14	4.85	B 3	
7447	ιAquilae	19 31.6	− 1 31	4.28	B 5	
7977	55 Cygni	20 45.5	+45 45	4.89	B 2	
8130	τCygni	21 10.8	+37 37	3.82	F	Discovered by J. S. Paraskévopoulos
8238	βCephei	21 27.4	+70 7	3.32	B 1	Discovered by E. B. Frost
8279	9 Cephei	21 35.2	+61 38	4.87	B 2	
8640	12 Lacertae	22 37.0	+39 43	5.18	B 2	Discovered by R. K. Young

scopic investigations. The minuteness of the amplitude of the light curve and of its variation are quite remarkable.

Among the above stars a certain number are already being investigated in greater detail at the Dominion Observatory, Ottawa, while 12 Lacertae is still under investigation by Dr. Young at the Dominion Astrophysical Observatory, Victoria. A large number of plates of τCygni and δCeti have already been secured by us,

and the velocities measured present interesting peculiarities which have not been found before in other stars.

Up to the present no logical explanation of the observed phenomena has been propounded; in the case of σScorpii a first attempt at an explanation has been made. We need more data, we need to investigate the systems more thoroughly; it is however not feasible, with the rather small telescope of the Dominion Observatory, to investigate the faintest of them; the brightest will constitute our programme of observation for the next few years; it might be advantageous if observatories with large telescopes would undertake the study of the faintest.

Quite possibly the same cause operates in all these stars. Are they binaries in formation? Are they rotating Jacobian ellipsoids? Or are they the translation into radial velocity language of peculiar loops in close three or multiple-body systems? This is the problem that awaits investigation.

Dominion Observatory.
Ottawa, December 1921.

MEETINGS OF THE SOCIETY

AT OTTAWA

The first meeting of the Fall Term was held in the Geodetic Survey Building on November 18. Mr. J. P. Henderson gave the lecture of the evening "Down the Mackenzie with a Wireless".

Mr. Henderson, with Mr. Miller, gravity specialist, and Mr. Swinburn, astronomical observer went in April last from the Dominion Observatory on the 3,800 mile trip from Ottawa to Norman, the farthest station which they occupied on the Mackenzie River. The primary object of the expedition was to determine the longitude, latitude and gravity. Longitude and gravity determinations can be made only by means of the use of the correct time. It was therefore the work of Mr. Henderson by means of the wireless equipment to receive the time signals from Annapolis, Md., San Francisco and San Diego, Cal. This made possible the longitude and gravity determinations in this far north country, where telegraphic communications do not reach at the present time.

The lecturer detailed the incidents along the journey from the beginning, exhibiting a splendid series of slides from photographs made by him along the route, from which the audience derived a good idea of the country, its resources and the difficulty of travel in penetrating the far north. For example, Mr. Henderson showed pictures of a sawmill which was pushing its way up the Peace River on a scow, having secured the necessary licensed captain—it having been discovered by the Mounted Police that a scow with a traction engine on board was a "steam vessel". Views were shown of the rapids which made the portaging necessary, of the scenery along the way and the settlements on this great waterway.

The portable wireless outfit employed was described and exhibited and some of the difficulties experienced were mentioned, notably those produced by "static" and the effect on the strength of the signals probably produced by local mineral deposits.

The determination of longitude and latitude was in co-operation with four topographical survey parties under Mr. Narraway sent out by the Department of the Interior and headed by Messrs. Blanchet, Bowman, Norrish and Seibert in preparation of a detailed survey of this rapidly growing country.

Dr. Ralph DeLury presided and announced that the next lecture would be given on December 9 by Mr. Miller on "Gravity in the Far North"

The second meeting of the Fall term was held in the Geodetic Survey Building December 9. Mr. A. H. Miller, M.A. (Oxon.), gave the lecture of the evening "Gravity in the Far North".

Dr. R. E. DeLury occupied the chair. Following the election of two new members: Mr. A. W. Grant, Dominion Observatory, and Mr. E. A. Jones, 1 Howick Place, Ottawa, Mr. Miller proceeded with his lecture, which was a continuation of Mr. Henderson's talk on "Wireless Down the Mackenzie".

The lecturer first gave a short history of the development in methods of determining gravity. Gravity is the pull or force exerted by the earth on matter. This force was first measured in 1657. It was not till 1890 that reliable results were obtained for gravity determinations. The most accurate method is by swinging a pendulum. A well-known formula gives the relation between the period, the length of the pendulum and the force of gravity. The method usually followed is to have a base point such as Ottawa, and relate other stations to it. There are many things which arise to make such determinations uncertain, such as pressure and temperature.

The earth is not a spheroid, the pole of the earth is 13 miles nearer the centre of the earth than a point on the equator. It is due to this difference, that the force of gravity at the equator measured in c.g.s. units is 978.03, while at the pole it is 983.06, since the force of gravity varies inversely as the square of the distance. On account of this a ton of freight "weighs" 3 pounds more at Norman than at Ottawa. This however could not be detected by ordinary scales, as the weights used would be correspondingly effected at both places.

The accurate determination of gravity is carried out in much the following manner. The pendulum is supsended on two accurate knife edges in a metal case which can be partially exhausted of air. The pressure chosen is 60 mm. and all determinations are made at approximately this pressure. The temperature is kept as nearly constant as is possible under field conditions. Temperature changes seriously affect accurate results. The pendulum is allowed to oscillate 8 or 12 hours, the arc of the oscillation, temperature and pressure noted both at beginning and end of period. Final results are all reduced to the same pressure and temperature.

Mr. Miller spoke of how fortunate he was in securing constant temperature places. These were usually ice houses belonging to the Hudson's Bay Co.; the temperature change was exceedingly small. The use of a tent for gravity work was not advisable, on account of temperature variations. Gravity observations are used in determining the flattening of the earth, also in the study of forces, geological formation and gravity bear a relation. The paleozoic formation shows a deficiency of gravity while the pre-cambrian an excess.

Mr. Miller's lecture was well illustrated with slides, showing his instrumental equipment as well as many points of interest relating to the country as a whole.

R. J. McDiarmid, *Secretary*.

AT MONTREAL

Dec. 15, 1921—In the absence of the President, H. E. S. Asbury, who unfortunately was indisposed, the chair was occupied by Mr. Justice Howard, the Vice-President. Attendance about 60.

This being the final meeting of the year, and the date of our Annual Meeting,

the Vice-President called upon the Secretary-Treasurer for his financial report for 1921. W. T. B. Crombie presented his statement which, with the new officers, will appear later.

The following were elected members of the Society: J. T. Armand, 58 St. James St., Montreal; J. E. Sanderson, c/o Sun Life Assurance Co., Dominion Square, Montreal; Geo. Hudson, c/o Bell Telephone Co., 47 Ontario St. W., Montreal; D. B. Thomas, P.O. Box 45, Montreal; R. A. Regnault, Pointe aux Trembles, Montreal.

The speaker of the evening was Mgr. C. P. Choquette, and his subject "A new explanation of Solar Radiation, with demonstrations and experiments". Mgr. Choquette presented a new aspect of the great problem of solar heat. As usually reckoned, the heat of the sun, spread all around on the surface of a sphere, the radius of which is the distance from the sun to the earth, that is, 93 millions of miles, amounts to bewildering figures. In a concrete form the sun's heat would be equal to the heat given by the burning, every 24 hours, of 2,000 times the totality of coal, available and in sight, that our globe contains. Other hypotheses such as the contraction of the sun or the bombardment of the sun by a regular and constant shower of meteorites would, besides many other objections, make the year longer in the first case, and shorter in the second. We must come to some sort of combustion derived from the chemical affinity between the elements of the sun. This is quite acceptable provided that instead of considering the sun's heat spreading in spherical waves and acting everywhere according to the golden law of the square of the distance, we accept the idea that the greatest part of this heat radiates rather, and only, along direct lines forming conical bundles of lines joining the surface of the sun to the surface of the planets. These cones of lines would contain all the sun's heat. In the theory of the sun's heat radiating in spherical waves, it is calculated that the known planets with their satellites, together with the telescopic planets, intercept only 1/227,000,000 of solar radiation. Then, if we agree that the sun's heat is all concentrated on the planets, it comes to the same as saying that the sun radiates the 1/227,000,000 part only of the amount given by former calculations. This question has been studied in this new line by some French astronomers. Mgr. Choquette finds and shows analogies in the change of direction of the lines of force of a magnet in the presence of a piece of iron, and specially in the direction of electrons by a cold plate in the vacuum tube now universally used in wireless telegraphy and telephony. Considering the small power consumed by the Hertzian waves travelling half around the world, from Lyons to Shanghai, will it be a pure illusion to think that these waves gather also in a kind of bundle towards any antenna?

At the conclusion of the address, Mr. D. R. Proctor Coates, of the Marconi staff of this city, who had kindly mounted a complete wireless receiving set of seven tubes, enabled us to hear a special radiophone concert.

As both Mrg. C. P. Choquette and Mr. Coates are members of the Society, a formal vote of thanks was not presented, but the appreciation of the audience was expressed by Rev. W. T. B. Crombie.

H. E. Markham, *Recorder.*

AT WINNIPEG

A regular meeting of the Society was held on November 23, 1921, in Room 21, University Arts Building, Professor N. R. Wilson in the chair.

The following were elected members of the Society: Gilbert Bartholomew, H. M. Guenther, Walter E. McCann, F. S. Nowlan.

These had been nominated by Professor L. A. H. Warren, seconded by Dr. C. D. Miller.

It was moved by Mr. Bastin, seconded by Professor Warren, that the executive prepare a list of nominees for the offices to be filled by election at the annual meeting, and send a copy of this list to each of the members in time for consideration at the annual meeting. The motion was carried.

A very interesting talk on the Zodiac was given by Mr. J. H. Kolb, after which Professor Warren gave a lecture on "Double Stars", telling of the large amount of work done in discovering and cataloging double stars, of the discovery of spectroscopic binaries and the methods used in detecting them, and giving a short outline of the life of Burnham, the noted astronomer, whose life-work was in the discovery of double stars.

C. D. MILLER, *Secretary.*

TEMPERATURES FOR THE MONTHS OF NOVEMBER AND DECEMBER, 1921

STATIONS	Nov. Highest	Nov. Lowest	Dec. Highest	Dec. Lowest
Yukon				
Dawson	22	−32	14	−30
British Columbia				
Atlin	44	−13	40	0
Agassiz	56	17	57	5
Barkerville	50	−18	40	−27
Kamloops	60	6	48	−12
New Westminster	57	24	55	13
Prince Rupert	56	14	58	14
Vancouver	57	23	54	11
Victoria	58	24	56	16
West Provinces				
Battleford	55	−15	45	−32
Calgary	67	−26	52	−30
Edmonton	52	−16	46	−36
Medicine Hat	68	−22	57	−21
Minnedosa	52	−23	40	−30
Moosejaw	56	−18	43	−25
Oakbank	45	−16	37	−33
Portage la Prairie	..	..	..	..
Prince Albert	52	−22	40	−36
Qu'Appelle	56	−26	40	−30
Regina	58	−23	42	−26
Saskatoon	56	−18	39	−37
Souris	54	−22	..	..
Swift Current	66	−20	50	−26
Winnipeg	46	−14	36	−26
Ontario				
Agincourt	63	18	51	−3
Oak Ridges	61	16	49	−7
Bancroft	56	0	43	−21
Barrie	61	15	49	−7
Beatrice	58	1	48	−19
Bloomfield	63	12	50	−8
Brantford	66	15	55	1
Chapleau	34	−9	..	..
Chatham	63	24	58	10
Clinton	61	21	52	4
Collingwood	62	10	50	−6
Cottam	65	20	..	..
Georgetown	63	14	51	−1
Goderich	..	..	52	2
Gravenhurst	..	..	..	..
Grimsby	67	16	53	2
Guelph	62	9	50	−3
Haliburton	60	3	47	−20
Huntsville	60	−1	49	−20

STATIONS	Nov. Highest	Nov. Lowest	Dec. Highest	Dec. Lowest
Ontario—cont.				
Kenora	42	−15	33	−29
Kinmount	..	..	48	−19
Kitchener	62	17	52	0
Kingston	63	14	51	−8
London	..	..	53	−6
Lucknow	61	17	52	0
Markdale	..	..	..	..
North Gower	69	8	50	−13
Oshawa	60	17	..	..
Ottawa	66	10	46	−14
Paris	62	12	53	2
Parry Sound	58	8	45	−14
Peterborough	64	9	47	−11
Port Arthur	48	−10	38	−22
Port Burwell	..	..	..	..
Port Dover	60	27	49	3
Port Stanley	62	20	51	2
Queensborough	62	2	47	−18
Ronville	60	5	48	−21
Southampton	59	20	53	3
Sundridge	..	..	..	..
Stonecliffe	..	....	..	..
Stoney Creek	66	17	55	3
Toronto	62	21	52	0
Uxbridge	58	14	50	−7
Wallaceburg	50	25	..	..
Welland	67	15	54	2
White River	42	−19	39	−45
Quebec				
Brome	71	0	44	−30
Father Point	52	2	38	−14
Montreal	64	11	48	−12
Quebec	60	6	39	−18
Sherbrooke	64	3	41	−21
Maritime Provinces				
Charlottetown	56	14	44	0
Chatham	56	0	38	−12
Dalhousie	..	..	..	..
Fredericton	..	..	50	−13
Halifax	64	16	52	4
Moncton	60	3	55	−10
St. John	54	12	45	−6
St. Stephen	..	..	..	..
Sussex	58	−5	53	−20
Sydney	60	20	46	6
Yarmouth	56	20	50	8

ASTRONOMICAL NOTES

THE REPELLING FORCES IN COSMOGONY

Les forces repulsives en cosmogonie, by Emile Belot (L'Astronomie, Vol. 35, p. 386).

Mr. Emile Belot is well known for his different articles in which he tries to explain the formation of our solar system by the impact of a spherical body, or proto-sun, on a loose nebula, (what he calls the dualistic theory).

In the present article he mentions that celestial mechanics has usually taken account of the Newtonian attraction alone but has never made extensive use of repelling forces, such as those due to the elasticity of a body which would play an important part after some impact (mechanical repelling forces) or such as radiation pressure (physical repelling forces).

Impact of a proto-star on a loose nebula would start the proto-star to pulsate and particles might be projected from this star at successive expansions of the pulsating body. Being projected at different intervals of time, and hence with different forces, they would go, at different distances of the proto-star, to conglomerate and form planets. Satellites would be explained in a similar way. This theory was illustrated by an interesting experiment: A theoretical sphere was made up of two metallic great circles cutting each other at right angles. When the sphere is set vibrating or pulsating the period of pulsation is constant. If the poles of the sphere are loaded with weights the period of pulsation increases. Such an increase of period would happen also in a proto-star by its increase of density after entering a nebula, and such probably is the case for our Sun which, according to Belot, when it had a radius of 0.29 astronomical units had a density, of 10^{-6} and a pulsation period of 5.5 days. While now its pulsation period is approximately eleven years (period of sunspot activity). The formation of planets is well illustrated by putting three small cylinders on a small equatorial platform attached to the sphere; the latter can be made pulsating in such a way that the three small cylinders are projected into space with different forces and at successive times.

Several other interesting ideas are found in the article; this is one of them: Lighter materials may be repelled, while heavier attracted (as in the case of radiation pressure versus gravitation); the lighter materials may have been pushed toward the limits of our stellar universe where by agglomeration it formed class B stars and nebulous clouds, while the heavier materials formed nearer by stars of classes F, G, K and M. Class B stars are as a rule much farther away from us than stars of the other classes mentioned.

F. H.

NEW FACTS ABOUT THE PLEIADES

The physical members of the Pleiades group, by Robert Trumpler (*Lick Observatory Bulletin*, number 333).

Dr. Robert Trumpler, of Zurich (Switzerland), who graduated several years ago from the University of Göttingen, devotes most of his time to the intensive study of this small group of stars, the Pleiades. In the present paper he gives us some valuable information, the results of his investigations made at the Lick Observatory. These are his conclusions:

The cluster of the Pleiades has a diameter of 10 parsecs (33 light years) and is situated at a distance of 100 parsecs (326 light years) from the Sun. The number of stars belonging to the group is between 300 and 500; these stars are at least ten times as densely distributed in the cluster as are the stars in the immediate neighbourhood of the Sun. The concentration is greatest toward the centre of the group.

The mean centennial proper motion of the group (5″.4 in position angle 157°.9), combined with a parallax of 0″.010 and a radial velocity of +10 km., shows that the Pleiades are moving relatively to the sun with a velocity of 27.5 km. per second in the direction of an apex whose coördinates are R.A., 82°.5, Decl., −40°.0.

The brightest star of the Pleiades, *Alcyone*, has a visual absolute magnitude of −2.2, which means that its absolute brightness is over 600 times the brightness of our Sun. The other stars range in brightness over an interval of at least eleven magnitudes, the brightest being thus about 25,000 times as bright as the faintest. No giant stars of classes A, F, G, K, are found in the Pleiades, but all the dwarf stars of these classes are represented, the sequence of classes being parallel to the sequence of absolute brightness; the brightest are of class B5 and so on. The classes F0 to F5 are represented by very few members, so that the cluster may be said to be formed of two groups, the brightest stars from B5 to F0 and the faintest beyond F5. The stars of the first group are much concentrated toward the centre of the cluster and their motions relatively to its centre of gravity seem to be exceedingly small.

F. H.

NOTES AND QUERIES

Communications are Invited, Especially from Amateurs. The Editor will try to Secure Answers to Queries

THE BRITISH ASTRONOMICAL ASSOCIATION'S "OBSERVER'S HANDBOOK"

Following the discontinuance of the "Companion to the Observatory" the British Astronomical Association has undertaken to publish an annual volume to supply its place. The first issue has been received, and along with it a letter from Major P. H. Hepburn, president of the B.A.A., offering an apology for appropriating the name "Observer's Handbook", which is the same as that used by the R.A.S.C. for a similar publication.

It would of course be better if the titles were different, though the R.A.S.C. cannot lay any exclusive claim to the name. Its first issue was in 1907 and was called "The Canadiar Astronomical Handbook", which title was used also in 1908. In 1909 and 1910 the contents of the annual volumes were published in the different issues of THE JOURNAL, but as this did not prove satisfactory the annual publication was resumed in 1911, but under the name "Observer's Handbook", and it has so continued up to the present. The volume for 1922 is the fourteenth of all, the twelfth under the title "Observer's Handbook".

It might be pointed out, however, that the British Meteorological Office publishes an annual volume under the very same name. In the preface (for 1917) it is stated that it is in continuation of Dr. Scott's "Instructions in the Use of Meteorological Instruments", which in its turn succeeded Sir H. James's "Instructions for taking Meteorological Observations", and that it was originally issued in 1908. This fact was not known when the R.A.S.C. began the use of the title and I do not think any confusion has arisen. Major Hepburn suggests the name "Observer's Yearbook" for the B.A.A. publication, and that certainly would remove any difficulty.

The new publication contains 36 pages, closely filled with

information. The contents include: Moonrise and Moonset, Rising and Setting of Planets, Planetary Phenomena, Eclipses, Longitude of Central Meridian of Jupiter, Phenomena of Jupiter's Satellites, Radiant Points of Meteors, Periodic Comets, Occultations of Bright Stars and Planets, Magnetic Elements, Mean Refractions, Variable Stars, Algol, Recent Measures of Double Stars, Test Objects of Various Apertures, Telescopic Objects, Definitions and Distinctions, Classification of Stellar Spectra, The Nearest Stars, Elements of Planetary Orbits, Astronomical Constants, Mathematical and Miscellaneous Constants, Dimensions of Sun, Moon and Planets.

The B.A.A. is to be congratulated on its publication. Some twenty of its members assisted in its preparation, and it is certainly a creditable production.

THE CHRISTMAS SCIENTIFIC MEETINGS

Between the 27th and the 31st of December last Toronto was invaded by a large army of scientists, but only with beneficial results. The American Association for the Advancement of Science first met in Toronto in 1889. At that time it had 1,952 members and the registration at the meeting was 424. Now the membership is approximately 12,000 and the registration at the recent meeting was over 1,800. It may be remarked that this was about twice as large as many had estimated and the supply of programs was soon exhausted.

The Society has 15 sections, running from A to Q, Section D being devoted to Astronomy. At one time it was hoped that the American Astronomical Society would meet with the Association, but the Society arranged to meet at Swarthmore, Pa. The Council of the R.A.S.C. approved the proposal that a special meeting of our Society be held in conjunction with the Association, and a request for papers from its members resulted in a creditable program of 23 being presented. The list appears on another page. The desire has been expressed that a similar meeting including papers from all the Centres be held every year, and if it can be arranged it will be of great value. The chief difficulty in the way is the fact that our country is such a large one and the workers are separated by great distances. C. A. C.

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This very scarce pamphlet, printed privately in 1863, was republished in the JOURNAL of the R.A.S.C. and can be obtained in a book of 126 pages. The work discusses the Year of the Pleiades and various questions relating to old calendars. It is of special interest to astronomers, anthropologists and ethnologists. Price $1.00, post-paid.

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